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| **Energy & Motion**   |  | | --- | | Newton’s laws of motion say that an object in motion tends to stay in motion, and an object at rest tends to stay at rest. When all the forces on an object are balanced, the object does not move. An unbalanced force is needed to change the speed or direction of any object. |   Friction and gravity are forces that are often acting on an object. But, if they are not unbalanced, they will not change an object’s motion. Without an unbalanced force, the object’s motion will not change. Forces such as friction and gravity often cause a moving object to stop moving. Forces such as a push or pull often cause an object to begin moving or change direction.   **SIMPLE MACHINES** Force must be applied to change the position or motion of an object. Simple machines are often used to multiply the force applied. This causes objects to move more easily. Examples of simple machines include the pulley, inclined plane, wedge, and lever. Diagrams of these simple machines are shown below.   |  |  | | --- | --- | | https://www59.studyisland.com/userfiles/7214pulley.jpg | https://www59.studyisland.com/userfiles/7214lever.jpg | | ***This pulley will make lifting the board easier.*** | ***Using the lever multiplies the force the man applies, making it easier to move the rock.*** | | https://www59.studyisland.com/pics/7214wedge.jpg | https://www59.studyisland.com/userfiles/7214inclinedplane.jpg | | ***The man is using a wedge and the pull of gravity on a hammer to split the log.*** | ***The man is using the board as an inclined plane because it makes loading the truck easier.*** |   **MOTION GRAPHS** The motion of an object can be determined by noting its position over time. This is often represented on a position vs. time graph. The slope of the line on a position vs. time graph tells about the motion of the object.   A straight line indicates a constant speed. If the line is going up from left to right, it means the object is moving forward, or that its position is changing in the positive direction. A straight line going down indicates that the object is moving backward, or that its position is changing in the negative direction. A horizontal line means the object is standing still. (see below)   |  |  |  | | --- | --- | --- | | https://www59.studyisland.com/userfiles/7214forward.jpg | https://www59.studyisland.com/userfiles/7214backward.jpg | https://www59.studyisland.com/userfiles/7214still.jpg | | ***Forward, constant motion*** | ***Backward, constant motion*** | ***No change in position = Standing still*** |   A changing slope, or curved line, indicates a change in speed. A line curving upward, or concave up, shows acceleration, or speeding up. A line curving downward, or concave down, shows deceleration, or slowing down. (see below)   |  |  | | --- | --- | | https://www59.studyisland.com/userfiles/7214acceleration.jpg | https://www59.studyisland.com/userfiles/7214deceleration.jpg | | ***Acceleration, or speeding up*** | ***Deceleration, or slowing down*** |   **SPEED** Formulas can also be used to determine motion. For example, speed is equal to distance divided by time. If an object is not moving, its speed is zero. If it moves 200 miles in 2 hours, its speed is:  200 miles ÷ 2 hours, or 100 miles per hour.  **USEFUL DEFINITIONS**   * **balanced forces**- forces acting in equal and opposite directions. Such forces cancel each other out. * **force**- a push or pull on an object which causes it to start moving, stop moving, or change directions * **friction**- a force that acts against motion when two surfaces rub against each other * **gravity**- a force used to pull objects toward each other * **inclined plane**- a flat surface with one end higher than the other, such as a ramp * **lever**- a simple machine consisting of a straight bar that pivots on a fixed point located off-center of the bar. The shorter end multiplies any force applied to the longer end. * **pulley**- a simple machine using a rope or chain which fits around a wheel * **wedge**- a simple machine made up of a solid material formed in the shape of a three-dimensional triangle. The point of the triangle can be used to drive two pieces of something apart. * **unbalanced force**- forces that are not equal. These forces cause a change in motion or direction. |
| **Factors Affecting Motion**   |  | | --- | | There are a variety of factors that affect the motion of objects. When studying object motion, the major factors that should be understood are **force, friction, inertia,** and **momentum**. |   **Force - a force is a push or a pull. A force is needed to start, stop, or change an object's motion. If an object is at rest or is traveling at a constant speed and direction, this means there is no net force acting upon it. In order for that object to start moving or change its motion, a net force must be applied.   Friction - friction is a force that opposes motion. When two objects are in contact with each other and a force is being applied to move one of the objects, friction opposes this motion.  Inertia - inertia is the tendency of a resting object to stay at rest and a moving object to stay in motion.   Momentum - momentum is a measure of how difficult it is to stop an object's motion. An object's momentum is calculated by multiplying its mass by its velocity. The greater the mass and velocity of a moving object, the greater its momentum.** |
| **Force**   |  | | --- | | An object's motion is the result of **force**. |   **Pushing or pulling forces can be used to move an object. The motion of an object is affected by the strength of a push or pull and the mass of the object. The stronger the push or pull, the faster the object will move.  But, if the same amount of force is used to move two objects with different masses, the object with less mass will move faster.  For instance, if the boy in the picture below pushed two different snowballs using the same amount of force, the snowball with less mass would move faster.**  **https://www59.studyisland.com/pics/SnowballPushing.jpg** |
| **Friction**   |  | | --- | | **Friction** is a force that is caused by two objects rubbing together. |   **Friction is a force that opposes motion, which means it causes motion to slow down or stop.**  **https://www59.studyisland.com/pics/12716box.jpg**  **For instance, it is the force that keeps a box from sliding across the floor when it is pushed. If a person is pushing on a box to slide it, then the two forces acting on the box are friction and the pushing force. If the box starts to move, then the force of pushing is stronger than the force of friction.  Friction can be reduced by smoothing the surfaces of the objects in contact with each other. For example, putting wax on skis reduces the force of friction between the skis and the snow. Pouring water onto a slide reduces the friction between a person and the slide, allowing the person to slide down more quickly.** |

**Simple Machines**

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| **Simple machines** are tools that make work easier. One way simple machines make work easier is by reducing the amount of input force needed. Another way simple machines make work easier is by changing the direction of the input force. |

**Types of Simple Machines**  
There are four main types of simple machines: inclined plane, lever, wheel and axle, pulley.  
  
**inclined plane** - An inclined plane is a flat surface that is slanted. Inclined planes reduce the size of the input force needed for a task by increasing the distance through which the force is applied. A *wedge* is a double inclined plane. A *screw* is an inclined plane wrapped around a shaft.  
  
**lever** - A lever is a rigid object that pivots around a point. The pivot point is called the *fulcrum*. A lever can reduce the amount of input force needed for a task by increasing the distance through which the force is applied. A seesaw, crowbar, wheelbarrow, and the human arm are all examples of levers.  
**wheel and axle** - A wheel and axle consists of an axle attached to the center of a wheel. It reduces the size of the input force needed for a task by increasing the distance through which the force is applied. When the wheel is turned, the axle is turned in the same direction. Because the wheel has a larger radius than the axle, the wheel moves a greater distance than the axle. As a result, the input force needed to turn the axle is reduced.  
  
**pulley** - A pulley is a rope threaded through a wheel or disk. It is used to lift objects. A pulley changes the direction of the input force. A pulley system, which consists of multiple wheels, can also reduce the size of the input force. A flagpole is an example of a pulley.

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| **Conservation of Energy** - It is important to note that while simple machines can reduce the amount of *force* needed to perform a task, they do not reduce the amount of *energy* or *work* needed to perform a task. For example, a ramp (inclined plane) *reduces* the amount of force needed to lift an object, but it *increases* the distance through which the force is applied. So, simple machines do not reduce work; they make work *easier*. |